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How Ohio's Highway Department Uses Transit-Mixed Concrete

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TRUCK or transit-mixed concrete as applied to highway construction is a comparatively new method. Its development has been such that only in the past two seasons has it come into more or less general use in connection with our work. It had been tried in a more or less experimental way at various times during the preceding four years, but the results were so variable that we did not consider it as standard practice until recently.

Most Extensively Employed in Placing Widening Strips and for Maintenance — Expect Mechanical Spreaders to Make Use Practicable for Full-Width Pavement Lanes

The principal objections to the first attempts were segregation of materials and inability to obtain uniform mixing. During the past two years, however, revolutionary changes have been made, and the methods now employed will undoubtedly occupy a more and more important place in highway construction and maintenance. The past season has seen a great deal of concrete placed by the truck or transit mixers—most of it satisfactorily.

Our program of salvage work whereby narrow widenings with curbs were placed has opened a large field for this type of work. The cost of moving a large mixer and the laying of a water line of sufficient size to take care of all operations was so high when distributed over the yardage involved, that many contractors have turned to the alternate method of placing ready-mixed concrete.

Another field which has been fertile for this method is our maintenance work, which involves a large amount of patching. It is a godsend on heavily traveled roads, since it does away with small stock-piles of material, which are always a source of waste and danger. Under the new scheme of things a maintenance gang can open up and prepare a sufficient yardage to take an entire load and place it in a few minutes. Formerly it was uneconomical to move in a large mixer, and with a one-bag outfit the process was so slow that traffic was unreasonably delayed.

The evolution of ready-mixed concrete has been so rapid that we have not attempted to write a definite specification for it. Our only requirement is that the product meet the same standard of quality as concrete mixed by the older and more established methods. During the past season very little trouble has been experienced in doing this.

Spreading Concrete Over Subgrade

Finishing machines designed to handle concrete from large mixers of the boom and bucket type do not lend themselves so well to handling concrete delivered in trucks. It is my understanding that the manufacturers have brought out a distributor to run ahead of the finishing machine, which will distribute the concrete evenly over the subgrade without segregation. This is accomplished by two screws, such as are used in conveyors, rotating in opposite directions. I have not seen this device in actual operation, but the photographs and description indicate that it will fill a very definite place in the manipulation of concrete placed in this manner.

I will now review a few of the projects which we built by the method under discussion. As a basis of comparison I might say here that our average strength for 1:5½ concrete in 1931 was 2,820 lb. per sq. in. at an age of 7 days; 3,520 lb. per sq. in. at 14 days, and 4,080 lb. per sq. in. at 28 days. These were the strengths developed by cylinders made on the job and shipped to the testing laboratory at Columbus. Complete averages for 1932 have not been computed.

One of the first projects on which transit-mixed concrete was used, where the equipment was comparable with that now in use, was in Champaign county on state route 53 during the construction season of 1931. It was used in connection with the 4-ft. widening of a 16-ft. concrete pavement. The equipment consisted of four 1½-yd. Jaeger transit mixers. The work was done partly as a demonstration to prove the feasibility of using it for the entire project. The concrete was of a 1:5½ mix and a gravel aggregate was used. The mixing time was approximately 25 minutes. Reports of engineers indicate that the concrete was well mixed and uniform in consistency. On

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Presented before the Third Annual Convention of the National Ready-Mixed Concrete Association, January 18, 1933.

this project about 80 per cent of the ultimate water content was placed in the drum at the source and the balance after the truck had reached the job. Only two tests were made and these were at an age of two days. The strengths were 2,030 lb. per sq. in. and 2,350 lb. per sq. in., respectively. These tests were not sufficient for any conclusions, but were very satisfactory as far as they went. At the end of two days the contractor decided that he could do the work more cheaply with a ¾-yd. mixer, so the job was completed by ordinary methods.

More Extensive Use in 1932

By the beginning of the 1932 season the use of ready-mixed concrete was better understood, and a number of contractors expressed a desire to try out this method. Permission was given in all cases, with the reservation that the concrete must equal that produced by the ordinary methods.

One of the first was a project in Ashtabula county, on the Cleveland-Buffalo road. This is one of the heaviest traveled roads in Ohio. The new pavement is 40 ft. wide and consists of two outside cement concrete lanes and a center of bituminous concrete. In order to meet the old pavement, which was to be resurfaced, it was necessary to build a strip of base on each side of it. This was done with truck mixers. One, and sometimes two, transit mixers were used. These strips were filled in twenty-four hours after the regular outfit had built the outside lane. The method proved to be economical and of great advantage in handling traffic. The regular tipple was used. The paving mixer was one yard and the transit mixer two yards, so no change in setting of weights was necessary to furnish a capacity load for the latter. The concrete was all of the same mix and tests for the concrete mixed by the regular paver and the transit mixer were not kept separate; but since all of the concrete was of satisfactory strength, it may be presumed that there was no reason to object to the ready-mixed portion.

Practically the same set-up was used on a similar project in Medina county, with good results. Ready-mixed concrete was used on the longest paving project ever built in Ohio. This was in Allen and Hardin counties on U. S. route 30. This job consisted of 24.75 miles of bituminous concrete resurfacing with widening strips of cement concrete. Real transit mixing was limited to the last three or four minutes of travel. The materials were hauled dry and the water added and the mixer started revolving so as to give an average mixing time of about three minutes.

The trucks used on this project were old and the loss of power while mixing en route was a real factor and slowed up the vehicle considerably. While hauling over traffic-bound roads it was noted that trucks had more of a tendency to sway while mixing than when idle. The tests on this project were not up to standard, but were not low enough to justify changing the entire set-up.

Sufficient Power Essential

To my mind the results on this project demonstrate the necessity of having sufficient power to carry on all operations simultaneously. The lack of power undoubtedly made the mixing operation more or less intermittent, so that the actual mixing time, based on a certain number of revolutions, may have been much less than that stated.

The fairest trial and the most complete records we have are on a project in Clinton county on state route 53, which is still under construction. This consists of two 2-ft. widening strips and a limited amount of full 20-ft. base where grade revisions were necessary. The mix was 1:5½, and washed limestone and limestone sand were used as aggregates. The placing of concrete began October 4, 1932, and is still being carried on when the weather permits. Five 2-yd. transit mixers were used.

In the beginning all materials and 75 per cent of the water were placed in the drum and the remaining water added on the job or near the end of the haul. This practice led to considerable variation in consistency, and it was changed. The best practice was found to be to add a fixed amount of water and mix during the entire haul. A small amount of water was reserved for washing out the machine before the return trip. The normal mixing time has varied from 10 to 50 minutes. One truck was delayed due to a flat tire and a 2-yd. batch was mixed for more than two hours. This batch was placed and for research purposes the location was carefully checked. There has not been sufficient time to note any difference.

Comparative Tests

The consistency and workability of the concrete on this project have been excellent and the quality can best be demonstrated by comparative tests. In order to get a fair comparison with sufficient samples to produce an authentic average, I had one of the men tabulate and average all tests for the year where the same aggregates had been employed.

The result for the 7-day tests, covering an average of 46 samples on the Clinton county job, was 2,600 lb. per sq. in., against 2,750 lb. per sq. in. for the general average. Twenty-four samples at the age of 14 days averaged 3,640 lb. per sq. in. against a general average of 3,471 lb. The samples at the age of 28 days, covering 29 samples, gave a strength of 4,100 lb. per sq. in. against a general average of 4,040 lb.

The transit-mixed concrete was under the general strength at the age of 7 days, but was higher than the average at the ages of 14 and 28 days. These results would seem to justify its use on any project where the method is applicable.

Conclusions Drawn from Experience Gained

Our experience would lead us to certain conclusions which may be tabulated as follows:

1. Equipment must be in good condition and the power unit must be able to furnish adequate mixing facilities while hauling.
2. The entire amount of mixing water should be added at the source and mixing continued throughout the haul.
3. If these rules are followed and the precautions taken which are dictated by ordinary concrete practice, a high class concrete can be produced.

So far no contractor has used this method for a full width project of any magnitude in our state, but I see no reason why this cannot be done with the modern appliances.

This method will not produce a super-concrete, nor can it be expected to revolutionize the entire industry; but I am convinced that it will produce good concrete and that its use will be greatly extended during the next few years.

Co-Ordination of Basic Principles of Concrete Mixtures

Further Review of Talbot-Richart Method of Proportioning and Discussion of A. S. T. M. Series 201 Constitute Eleventh Article of Series

XI—Needed Laws of Mixtures and Known Fundamentals; Review of Concrete Mixture Research (Continued)

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FROM the test data of Series 211 (*Bul.* 137, Univ. of Illinois) Talbot and Richart derived an equation of strength for concretes of "Basic Water Content"—

$$S = \frac{32,000}{\left(1 + \frac{v}{c}\right)^{2.5}} = 32,000 \left(\frac{c}{v + c}\right)^{2.5} \quad . \quad . \quad . \quad . \quad (40)$$

in which S is the compressive strength at 28 days, c is the absolute volume of cement, and v is the corresponding volume of voids (water and air) in a unit volume of concrete of the given aggregates and cement. "Basic Water Content" is that water content which produces concrete of maximum density with the given quantities of cement and aggregates; it closely approximates "normal consistency" and gives a slump of ½ to ¾ in.

This equation is shown to be true for the given consistency of mix, given quality of aggregates and cement, and for varied grading and maximum size of aggregates, and for varied cement content. Correction for "Relative Water Contents" (1.1, 1.2, 1.3, etc., times Basic Water Content) is made by a Reduction Curve (Figure 30, *Bul.* 137) showing values as in the following table:

REDUCTION VALUES FOR CONCRETES OF VARIED WATER CONTENT

Relative Water Content	Percentage of Strength Shown by Equation 40
1.00 (Basic)	100
1.10	95
1.20	85
1.30	73
1.40	66
1.50	63
1.60	62

Strength, Voids-Cement and Water-Cement Ratios

Figure 25, *Bulletin* 137, shows for the Basic Water Content tests of Series 211 that the strength also varies with the voids-cement ratio according to the equation—

$$S = \frac{5,683}{(v/c)^{1.65}} \quad . \quad . \quad . \quad . \quad . \quad . \quad (41)$$

$$\text{or } \log S = 3.7546 - 1.65 \log (v/c) \quad . \quad . \quad (41a)$$

For varied water content, the reduction values for Equation (40) should apply to Equation (41).

Figure 6, *Bulletin* 137, shows for the regular gradings of Series 2G (exclusive of the very coarse gradings) that the strength varies with the voids-cement ratio in accordance with the equation—

$$S = \frac{7,577}{1.783^{(v/c)}} \quad . \quad . \quad . \quad . \quad . \quad . \quad (42)$$

$$\text{or } \log S = 3.8795 - 0.25111\, v/c \quad . \quad . \quad (42a)$$

The corresponding equation on the basis of the Abrams W/C ratio (excluding the very coarse gradings of Series 2G) is—

$$S = \frac{10,019}{4.772^{W/C}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (43)$$

$$\text{or } \log S = 4.00082 - 0.6786\, W/C \quad . \quad . \quad (43a)$$

Voids-Cement and Water-Cement Ratios Related

The relation of v/c to W/C, shown by the same values determining Equations (42) and (43), is found to be as follows for the given consistency:

$$v/c = 2.705\, W/C - 0.4885 \quad . \quad . \quad . \quad (44)$$

$$\text{or } W/C = 0.370\, v/c + 0.1805 \quad . \quad . \quad . \quad (44a)$$

If strength is plotted as ordinate, and both v/c and W/C plotted as abscissa with the two abscissa scales determined by Equation (44), the same curve represents Equations (42) and (43). As the void space in a unit volume of concrete is represented by the water and entrapped air in the freshly molded mix, and the air is in small proportion in the usual mixtures, it is logical that there is a definite relation between voids-cement and water-cement ratios as shown by Equation (44). It should be kept in mind, however, that for a given cement content and water-cement ratio the strength depends on the relative densities of the respective mixes as affected by the character of grading of the mixed aggregate. This was shown in Part X, CONCRETE, February, 1933, pages 9-11. The regular gradings of Series 2G show 30 to 40 per cent greater strength and 5 to 6 per cent greater density than the irregular gradings of Series 2G and 211, for given maximum size of aggregate, cement content, fineness modulus and water-cement ratio.

Equation (41), showing the relation of strength to the voids-cement ratio for Series 211, is a "log-log" curve, while Equation (42), showing the same relation for Series 2G, is a "semi-log" curve. The significance of this is not clearly indicated. The difference in the character of the two curves may be due to the specific difference of the mixtures in the two series, that is, regular gradings of aggregates in Series 2G and irregular gradings in Series 211.

Talbot-Richart Method

The Talbot-Richart method of proportioning is based on the following:

(1) The relation of strength to voids-cement or cement-space ratio, Equation (40).

(2) Mortar-voids tests of individual fine aggregates and cement.

(3) Graphical analysis of mortar-voids tests showing curves of water content, cement content and ratio of voids to cement for varying ratios of absolute volume of fine aggregate to absolute volume of cement, and for various relative water contents.

(4) An equation or diagram showing the relation of the strengths of mortar and concrete for given cements.

(5) A reduction curve for effect of relative water content as compared with basic water content.

(6) A thorough development of the physico-mathematics of mixtures and of test analysis.

The development of the absolute volume technique is a major accomplishment in the history of concrete. The weight-volumetric technique of the mortar-voids test is an artful application of the physics involved in simplification and accuracy of measurement of yield and density, and of contents of cement, aggregate, water and air in a unit measure of mortar or concrete. This record provides a textbook of fundamental concrete physics.

Bulletin 137 contributes important items to the problems of central plant production of concrete:

(1) The absolute volume basis of measure supplies the only practical means of accurate determination of yield, and simplifies the whole technique of material and concrete tests, of analysis, and of proportioning.

(2) The solution of the central plant practical problem of employing from 3 to 6 or more size separations of aggregate, in mixtures of various maximum sizes and cement contents, is indicated by the Talbot-Richart grading equation and its initial co-ordination with the fineness modulus principle.

(3) The answer to the economical problem of obtaining concretes of maximum density and strength, for given conditions of cement content, maximum size of aggregate, and cohesion and workability of mix, is definitely indicated by the comparative results of regular and irregular gradings of Series 2G and 211.

(4) The central plant problems of producing concretes accurately in accordance with the varied requirements of the many buyers of concrete depend for solution on one or more items of concrete physics, method or technique presented in *Bulletin* 137.

A. S. T. M. Series 201

A series of tests designated as "Series 201" was outlined in 1920 by Committee C-9 of the American Society for Testing Materials as a "study of the effect of size and grading (fineness modulus) of aggregate and of variations in the quantities of cement and water on the strength and other properties of concrete." (See *Proceedings*, A.S.T.M., Vol. XX, Part I, p. 294, 1922.) The co-operating laboratories and those reporting data of tests in 1922 were:

Department of Public Works, Philadelphia, Pa., F. B. Lysle, Chemist, Bureau of Surveys.

University of Texas, Austin, Texas, H. R. Thomas, Testing Engineer, Division of Engineering.

University of Toronto, Toronto, Canada, Peter Gillespie, Professor of Civil Engineering.

Hydro-Electric Power Commission of Ontario, Toronto, Canada, F. A. Gabey, Chief Engineer.

The reports of the collaborating laboratories were summarized by D. A. Abrams in Appendix II, Report of Committee C-9, *Proceedings*, A. S. T. M., Vol. 22, Part I, p. 329 (1922).

No analysis of the data of Series 201 was published until 1927. In the interim the Talbot-Richart tests of Series 2G and 211 (previously described) had been reported in 1923; and a series of tests, supplementary to Series 201 and giving consideration to the Talbot-Richart cement-space ratio-strength theory, had been made by R. Shaw and M. C. Steffen at the University of Wisconsin.

In order to test the validity of the several new theories of proportioning concrete mixtures, Messrs. R. A. Nelson and B. F. Smith, under the direction of Prof. M. O. Withey, of the University of Wisconsin, undertook a study of the data in Series 201, including the Shaw and Steffen tests, to determine the relations of the compressive strength of concrete to Abrams' water-cement ratio and Talbot's cement-space ratio, also to the fineness modulus, surface area, surface modulus of mixed aggregate, and to relative consistency of mix. The results of this study are presented by R. A. Nelson in Appendix I, Report of Committee C-9, *Proceedings*, A. S. T. M., Vol. 27, Part I, p. 361 (1927).

The results of the strength tests in relation to water-cement ratio and space-cement ratio (reciprocal of the Talbot-Richart cement-space ratio) were plotted on semi-log, log-log, and rectangular co-ordinate paper to determine the equations of the mean curves representing the relationships.

The equations of the mean curves best representing the strength were found to be—

$$S = A/B^x \quad \ldots\ldots\ldots \quad (21)$$

$$\text{and } S = M/N^z \quad \ldots\ldots\ldots \quad (45)$$

in which S is the compressive strength, A, B, M and N are constants for the given conditions; exponent x represents Abrams' water-cement ratio, W/C; and exponent

$$z = \frac{v + c}{c}$$

reciprocal of the Talbot cement-space ratio. These are both semi-log curves in which x and z hold similar relations to S.

It does not appear that the relation of W/C to $(v+c)/c$ was graphically analyzed by Nelson and Smith, but their relation was determined for each group of tests by placing the two equations (see Equation 46) for strength equal to each other and solving for the water-cement ratio, x, in terms of the space-cement ratio, z.

The equations of the mean curves of strength found by Nelson and Smith for the individual tests, are as follows:

Laboratory and Method	W/C Basis	$(v+c)/c$ Basis	
Texas*	$S = 12{,}400/\ 7.94^x =$	$29{,}500/2.63^z$	(46)
Texas†	$S = 9{,}300/\ 3.66^x =$	$37{,}000/2.94^z$	(46a)
Ontario*	$S = 18{,}000/\ 9.02^x =$	$18{,}300/2.07^z$	(46b)
Toronto*	$S = 17{,}000/\ 9.70^x =$	(‡)	(46c)
Philadelphia*	$S = 12{,}000/11.9^x =$	(‡)	(46d)
Wisconsin*	$S = 17{,}800/10^x =$	$31{,}000/2.25^z$	(46e)

*Standard. †Rodded. ‡Not determined.

The corresponding relations of the water-cement and space-cement ratios were found, from the respective equations, Nos. (46), (46a), etc., to be as follows:

Texas (standard)	$x = 0.467z - 0.418$	(47)
Texas (rodded)	$x = 0.833z - 1.065$	(47a)
Ontario (standard)	$x = 0.331z - 0.007$	(47b)
Toronto (standard)	$x =$ (not determined)	
Philadelphia (standard)	$x =$ (not determined)	
Wisconsin (standard)	$x = 0.355z - 0.241$	(47e)

Talbot and Richart have shown in *Bulletin* 137 that the effect of the cement-space ratio, $c/(v+c)$ on the strength varies with the consistency or relative water content of the mixtures as indicated by the reduction curve, for Equation (40), given preceding. It therefore follows that the effect of the reciprocal, $(v+c)/c$, on the strength varies with the consistency of the mixtures. Then, the Nelson equations of strength with reference to the space-cement ratio, Equations (46), (46a), etc., are true only for the average consistency of the Series 201 mixtures on which they are based. Likewise, Nelson's equations of the respective relations of the space-cement to water-cement ratios, Equations (47), (47a), etc., are true only for the average consistency of the Series 201 mixtures determining Equations (46), (46a), etc. The following direct comparison, by the author, of the water-cement and space-cement ratios, shows that there is a different straight-line relation for each consistency.

Relation of W/C to (v + c)/c Depends on Consistency

Examining the effect of consistency on the relations of water-cement to space-cement ratios, for the Wisconsin group of Series 201, we find the following straight-line equations for the respective consistencies:

Consistency	Relation of W/C and $(v+c)/c$	
1.00	$x = 0.355z - 0.2775$	(48)
1.10	$x = 0.370z - 0.2750$	(48a)
1.25	$x = 0.390z - 0.2550$	(48b)
1.50	$x = 0.425z - 0.2325$	(48c)

$[x = W/C$, and $z = (v+c)/c]$

Similar relations are indicated by the Series 201 tests of the other collaborating laboratories. It is evident, therefore, that the comparative effects of the water-cement and space-cement ratios, on the strengths of concretes of various consistencies, depend on the relative consistencies, or the relative water content of the mixtures as the relation of W/C to $(v+c)/c$ varies with the relative water contents of the mixtures.

W/C Versus c/(v + c) as the Basis of Strength

It is evident from Talbot's Series 2G and 211 and Nelson's analysis of the Series 201 sponsored by Committee C-9 of the A. S. T. M., that the effect of the W/C ratio on the strength is not independent of the voids in, or density of, the resulting concretes; and, that the effect of the density of the concrete or of the voids-cement, or space-cement ratio, on the strength, is not independent of the relative water contents of the mixtures. Eliminating impractical mixtures such as those which are too wet, too dry, or too coarsely graded, the water-cement ratio strength equation is more generally correct than the cement-space ratio-strength equation. Going a step further and eliminating irregular gradings of the mixed aggregates, the water-cement ratio-strength equation $S = A/B^x$ is very satisfactorily general for all practicable mixtures of given materials and under given technological conditions.

The relation of strength to density of concrete, as shown by Talbot and Richart, is a very important fact of concrete physics, but density is not an ingredient which may be added to the mixture at will. The problem is to take the respective materials and combine them for the maximum practicable density or optimum density of concrete for the given conditions of maximum size of aggregate, cement content and workability of mixture. The accomplishment of optimum density and, likewise, optimum strength, for given conditions of maximum size, cement content and workability, evidently depends on the widely accepted principle of uniform grading as discovered by Fuller and Thompson and as amply proved by our comparison of the regular and irregular gradings of the Talbot and Richart Series 2G and 211. (See Part X, in CONCRETE, February, 1933, pages 9-11.)

No Absolute Water-Cement Ratio-Strength Law

Nelson's analysis of Series 201 shows a different water-cement ratio-strength equation for each collaborating laboratory, evidently due to different materials and different technique. Talbot and Richart show different equations for Series 2G and 211, evidently due to regular and irregular gradings of the aggregate mix. Abrams shows different equations, in his Series 201, *Bulletin* 4, S.M.R.L., obviously due to difference in cements and to difference in fineness of grinding of a particular brand of cement. It is positively established that there is no water-cement ratio-strength equation fitting all conditions.

Strength of concrete of given maximum size of aggregate, cement content, water-cement ratio, and workability or slump, evidently depends on character and quality of materials, character of grading of mixed aggregate as it affects the density of the resulting concrete, and on technological conditions of proportioning, mixing, placing and curing, as well as on water-cement ratio. In the individual case of a given type of mixture, many variables are involved in its composition and many more variables are involved in its production, all of which have an effect on its strength. There are many facts of the physics and technology of mixtures which must be appreciated, in order to insure strength, durability and other qualities, and formulas of strength comprehending only one variable are evidently very limited in their scope of application.

Professor Otto Graf, of Stuttgart, Germany, has evolved an equation of strength based on two variables—(1) water-cement ratio and (2) strength of the normal neat cement—and including constants for the expected maximum and probable minimum strengths of the concrete, the probable minimum being one-half the expected maximum, quite a wide variation. (See "Der Aufbau Mörtels im Beton," by Otto Graf, Berlin, 1923.) Professors Talbot and Richart differentiate for the two variables cement-space ratio and relative water content. Progress in knowledge of concrete mixtures depends on studies along similar lines. We must first determine and co-ordinate the fundamentals, however, before much progress can be expected in the differentiation of the many individual variables affecting the strength, density and other characteristics of mixtures.

Selling Theme of Iowa Products Meeting at Des Moines

How to sell more concrete products in 1933 was the theme of the annual convention of the Iowa Concrete Products Association held at Des Moines, February 2.

Harold Spaight, Cedar Rapids, was elected president, Jess Rector, Des Moines, vice-president, and Wm. M. Alsin, Des Moines, secretary-treasurer.

American Concrete Institute Sessions Draw Large Attendance

Well Balanced Program Holds Interest of Delegates — Vibrated Concrete a Big Subject—Exhibit of Architectural Concrete—Whitney and Powers Win Medals

WITH a registration considerably above 300 and a well balanced program for the instruction of convention delegates, the American Concrete Institute held one of its most successful annual meetings at the Palmer House in Chicago.

The twenty-ninth annual meeting of this organization will not go down in history as the most largely attended, for in more happy times the attendance has reached 600 on several occasions. Instead, the recent meeting can be classed as one in which the delegates came for the purpose of learning and exchanging ideas. The sessions were well attended and the attention was concentrated on the subjects in hand.

With the permission of the officers of the Institute, CONCRETE will print abstracts of many of the papers presented at the convention, starting with the next issue.

Vibration Is Big Topic

The first session, on Tuesday afternoon, February 21, was devoted entirely to the subject of placing concrete by means of vibration. Four papers were presented on this subject, and these were followed by several scheduled discussions and much informal discussion.

Raymond E. Davis, professor of civil engineering, University of California, presented the first paper, in which he discussed the application of three types of vibrators to the placing of concrete in large masses, as in dams.

Miles N. Clair, vice-president of the Thompson-Lichtner Co., Boston, followed with a paper which dealt to a considerable extent with the action of concrete when subjected to high-frequency vibration. He also told of the application of vibration in the manufacture of cast stone, and in the production of various concrete products.

T. C. Powers, associate engineer, Portland Cement Association, told of progress made and results thus far attained in the experimental work now being conducted by the research laboratory of the association. One of the facts which seems to be demonstrated by the tests is that vibration of any given mixture of concrete will not necessarily increase the strength of that mixture above what it will be if properly placed by ordinary placing methods. The advantage of vibration lies in the fact that mixtures of stiffer consistency can be placed in a given location than is possible with ordinary hand-placing methods. For that reason, vibration will make it practicable to utilize either a lower water-cement ratio with the same cement content, or the same water-cement ratio with a lower cement content, than if hand-placing methods are used. This, of course, means higher strength in the one case and lower cost of materials in the other.

F. V. Reagel, engineer of materials, Missouri state highway department, read a paper describing the experimental concrete roads built by the highway department during 1932, as a means of determining the effects of vibration on highway concrete. The physical characteristics of the vibrated and unvibrated concrete have been studied by means of cores taken from the pavements, and observations are being made on possible differences in performance under service conditions.

Architectural Concrete

The Baha'i Temple, at Wilmette, Ill., the structural features of which are described and illustrated in the May (1931) issue of CONCRETE, pages 11-13, came in for much attention during the evening session of February 21, and also on Wednesday morning, February 22, when the convention delegates inspected the structure.

The Tuesday evening session was devoted entirely to architectural concrete. First on the program was a series of three papers on the Baha'i Temple, the first of which was an illustrated talk by Allen B. McDaniel, representing The Research Service, Washington, D. C., in which attention was centered on the architectural concrete employed in the window tracery and other ornamental work, both exterior and interior. Mr. McDaniel was followed by Benjamin B. Shapiro, consulting engineer, Chicago, who described the structural design of the structure. John J. Earley, architectural sculptor, Washington, D. C., then described the ornamental concrete work on the temple, this work having been placed by his organization.

"Recommended Practice for Architectural Concrete Construction," a progress report of Committee 409 of the American Concrete Institute, was presented by Arthur R. Lord, consulting engineer, Chicago, who is chairman of the committee. It was partly in connection with this report that an interesting exhibit was arranged in the fourth floor lobby of the Palmer House. The exhibit included a number of large-size panels of monolithic architectural concrete, finished in various colors and textures. Surfaces obtained with special materials such as presdwood, plywood, and rubber matting, were shown, while other panels were cast in waste molds.

"Painting on Concrete Surfaces," a report of Committee 407 of the American Concrete Institute, was presented and briefly discussed by F. O. Anderegg, consulting specialist on building materials, Pittsburgh, Penna., who is author-chairman of the committee. This report was previously published—in the September issue of the A. C. I. *Journal*—and was abstracted in the December (1932) issue of CONCRETE, pages 13-14.

The Hoover Dam

The Hoover dam supplied the inspiration for much of the program presented on Wednesday evening, February

22. At the afternoon session of the same day the paper describing the selection of the concreting plant for the Meadowbrook Hospital contract, which was to be presented by John G. Ahlers, was read by title only, due to the absence of the author.

Inge Lyse, research assistant professor of engineering materials, Lehigh University, then presented his illustrated report of experiments conducted at the university to determine the relation between the quality and the cost of concrete. The experiments represent a well-directed effort to get the answer to the question often raised as to how far the concrete technologist is justified in going in obtaining qualities such as high strength and great density. The answer depends, of course, upon many factors, which the author has weighed and considered.

The evening session, as stated, was taken up with papers covering various phases of the studies made in connection with Hoover dam. In the first of these papers Byram W. Steele discussed the research in placing mass concrete, conducted as a part of the Hoover dam studies. Data previously obtained during the construction of Owyhee dam have been extensively utilized in this research.

Raymond E. Davis then presented the results of an elaborate investigation of cements, being conducted at the University of California by Prof. Davis, R. W. Carlson, G. E. Troxell and J. W. Kelly, in connection with the Hoover dam project. This paper covered in detail the chemical compositions of various cements, and the effect of variations in composition on strength, heat generation, and other factors.

Next a joint paper by Arthur Ruettgers and R. F. Blanks was read by the latter, in which the authors made a comparison of various cements with respect to heat generation, strength, flow under sustained load, volume change and elastic properties under mass concrete conditions. Due to the absence of the author, Mr. Blanks also presented the paper by H. S. Meissner on the development of large calorimeter rooms and automatic temperature controls for the adiabatic curing of mass concrete.

Additional papers dealing with the Hoover dam were read at the afternoon session of Thursday, February 23. These included a paper on "Thermal Properties of Mass Concrete," by L. J. Snyder and C. S. Rippon; another reported the effect of size of aggregate, size of test specimen and proportions of mixture on the compressive strength, elastic properties and permeability of mass concrete, by Arthur Ruettgers and R. F. Blanks; and a third paper describing the development of apparatus and technique for measuring elasticity of mass concrete, by Emile N. Vidal.

O. G. Patch read a paper at the Thursday afternoon session in which he described an 8-hour accelerated test for field control of concrete.

Reinforced Concrete Column Tests

The session of Thursday evening, February 23, was taken up largely with papers and reports affecting structural design. The first was a paper on "Rigid Frame Concrete Bridges," by J. W. Beretta, consulting engineer, San Antonio, Texas.

Reports on the results of the reinforced concrete column tests conducted during the past few years under the sponsorship of the Institute were presented in three parts. Inge Lyse presented the fifth report on the part of the tests conducted at Lehigh University. F. E. Richart, in charge of the tests conducted at the University of Illinois, then presented the tentative final report of Committee 105 of the American Concrete Institute, under whose jurisdiction the tests were made. Then Prof. Lyse presented a minority report, signed by himself and R. L. Bertin, in which the proposed column formula differs to, some extent from the formula proposed in the main report by Prof. Richart, who is chairman of the committee. It is hoped that in an early issue of CONCRETE the gist of both reports may be printed.

Whitney and Powers Win Medals

Charles S. Whitney, consulting engineer, Milwaukee, Wis., was awarded the Wason medal "for the most meritorious paper presented at the 28th annual convention," the paper in question having been entitled "Plain and Reinforced Concrete Arches."

T. C. Powers, associate engineer, research laboratory, Portland Cement Association, Chicago, was awarded the Wason research medal for work reported in his paper, "Studies of Workability of Concrete," published in the *Journal* of the A. C. I., February, 1932.

Hollister and Bates Re-Elected

S. C. Hollister, professor of structural engineering, Purdue University, Lafayette, Ind., was re-elected president of the Institute, and P. H. Bates, chief of the ceramics section of the National Bureau of Standards, Washington, D. C., was re-elected as one of two vice-presidents.

Muenzer Urges Products Men to Join Concrete Masonry Association

Editor, CONCRETE:

I have just had the pleasure of attending the annual meeting of the Concrete Masonry Association in Chicago and found the program very instructive. Every minute seemed to bring forth some practical ideas for the betterment of concrete masonry.

As a manufacturer of concrete-making equipment I can heartily commend the work that the Concrete Masonry Association is doing for products men as a whole, in its promotion of the use of concrete masonry.

Every products manufacturer should be a member of the association and support it in the conduct of its program. The small annual dues of $10 will be a very small sum compared with the benefits to be obtained from the promotional work that this organization is doing. By joining up with the Concrete Masonry Association the products manufacturer will be in a position to get his share of the business.

FRANK MUENZER, *President*
Multiplex Concrete Machinery Co.

Elmore, Ohio
February 25, 1933

Black Granite Deposit Is Found in Nova Scotia

It is a matter of possible interest to manufacturers of cast stone in the eastern sections of the United States and Canada that an important deposit of black granite has been uncovered near Loch Katrine on the border line between Antigonish and Guysborough counties, Nova Scotia, according to information received by the natural resources department of the Canadian National Railways. The deposit covers a wide area and the stone is of good quality.

As black granite has always been imported from Sweden, it is believed that there will be a large and ready market for the newly found product. Marketing plans are now being made by a Nova Scotia syndicate.

Concrete Masonry Association Sees Opportunity Ahead

New Products and New Markets Create Interest at Annual Meeting—Sessions Are Well Attended—Collins Tells of Work at Washington

An unexpected attendance of some fifty delegates at the annual meeting of the Concrete Masonry Association, held at the Palmer House, Chicago, on February 23, provided mutual encouragement to all.

The papers arranged for the convention program were of exceptionally high quality, and without a doubt the authors put their best efforts into them. It will be the privilege of CONCRETE, with the permission of the authors and the officers of the association, to print most of the papers, the first of which appears in this issue under the heading "Precast Concrete Joists Called Key to Firesafe Homes."

Precast Floor Joists

The paper just mentioned, presented by E. W. Dienhart, of the Portland Cement Association, resulted in an extended discussion of the marketing possibilities of this interesting precast product, the reinforced concrete floor joist. It is expected to serve as a definite aid in extending the use of concrete first floors in dwelling house construction.

D. R. Collins, president of the Concrete Masonry Association, who represents the interests of this industry at Washington, told of his work in considerable detail in a paper entitled "What the Federal Government Has Ahead, and Your Share in It." Through these activities concrete masonry has been written into many specifications for government buildings, whereas without the work carried on at Washington this product would have received no consideration. Yet constant vigilance and constant contact with the construction sections of governmental departments are necessary in order to hold the ground gained. Numerous orders for large quantities of concrete masonry units can be traced directly to this vigilance.

Facts About Concrete Masonry

"How Concrete Masonry Manufacturers Can Make Use of 'Facts About Concrete Masonry' " was the subject of a paper by Einar Christensen, consulting engineer, National Building Units Corp., New York. Mr. Christensen offered many constructive suggestions looking toward effective use of this excellent book, which was reviewed on page 25 of the August (1932) issue of CONCRETE. Issued by the Concrete Masonry Association from its head office, 7071 Plankinton Bldg., Milwaukee, Wis., this book is designed especially for the information of architects, engineers and specification writers. It contains essential data such as nationally accepted specifications, reports of tests, and numerous details showing the proper methods of placing concrete masonry units.

Roy McCandless, president of the Cinder Units Corp., Detroit, Mich., presented a paper entitled "Concrete Ashlar—An Opportunity to Change Ideas." This interesting product, always a matter of interest, has attracted the attention of many architects who previously had not given much consideration to concrete masonry units. The architectural effects obtained in both interior and exterior work, and the progress made by concrete ashlar, have been a source of surprise and admiration in many quarters.

The Fireproof Home

"The Fireproof Concrete Home—A Tremendous Market Ahead," was the subject of a talk by W. D. M. Allan, manager of the cement products bureau of the Portland Cement Association. After quoting statistics showing the normal annual requirements in dwelling house construction, Mr. Allan built up a picture of the great volume of concrete masonry units and special precast products which can be utilized in that market.

The Concrete Masonry Association itself was the subject of an interesting paper by Benjamin Wilk, general manager, Standard Building Products Co., Detroit. He reviewed the past good record of the association, then discussed some of the work remaining to be followed up with a relentless pursuit. Studies of the economy in using concrete units in low-cost housing, the need for fair-dealing regulations in building codes, getting an even break for concrete units in government specifications, and distributing appropriate publicity matter, are a few of the activities that must be kept up and pushed forward. If the industry is to realize on what can be seen ahead of us, Mr. Wilk declared, products manufacturers must give active support to their association.

Present officers of the association were re-elected for the current year. These include D. R. Collins, president, Washington, D. C.; Austin Crabbs, vice-president, Davenport, Iowa; and Jack Franklin, secretary, 7071 Plankinton Building, Milwaukee, Wis.

A Rational Expression for Fineness of Portland Cement

How Coefficient of Effective Fineness Is Determined—Strength, Plasticity, Impermeability and Resistance to Chemical Action Enhanced by Increasing the C. E. F.

By E. W. REED-LEWIS
Director of Research, The Super Cement Company, Detroit, Mich.

At the end of the article headed "Determines Sub-Sieve Fineness of Portland Cement," printed in last month's issue of CONCRETE, the author promised this additional article dealing with the "Coefficient of Effective Fineness" as a rational expression of effective fineness in portland cement, and with the influence of "Effective Fineness" on the strength and some other characteristics of cement.

Since the purpose of pulverizing portland cement is to increase its hydraulic activity, and since the purpose of a fineness test is, usually, to determine how effectively the pulverizing operation has been carried out, an expression of the result of a fineness test should be based on considerations of "effective" particle size, rather than "actual" particle size, wherever the two are not synonymous.

If the useful activity of a 4-micron particle of cement has not been enhanced by shattering it into sixty-four 1-micron particles, with a consequent four-fold increase in specific surface, then neither the sixty-four-fold increase in the number of particles nor the four-fold increase in specific surface should receive consideration in expressing the effective fineness of the cement.

Expressing Fineness as a Definite Value

This basic principle of discriminating between actual particle size and effective particle size was recognized some years ago, when the author devised the "Coefficient of Effective Fineness," or "C. E. F.," as a convenient means of reducing the cumbersome fineness analysis of a cement, expressed in percentages of several different size groups, to a single numerical value of useful significance.

By way of encouraging the reader to familiarize himself with this expression of effective fineness, attention is here directed to Figure 4, which illustrates the relation between C. E. F. and the compressive strength of concrete, with a water-cement ratio of 0.8.

The strength values indicated in Figure 4 are for Super Cement. Similar relationships between C. E. F. and strength can, of course, be equally well established for other varieties of portland cement. When so established, strength can be forecast from a fineness analysis with an accuracy usually within 5 per cent.

How C. E. F. Is Determined

The C. E. F. is derived from the fineness analysis by making a summation of the products obtained by multiplying the percentage of each size group by the reciprocal of the mean effective diameter of that group. For example:

Size group	Mean effective diameter	Reciprocal	Percentage by analysis	Product
Minus 10 mu.	7.0 mu.	0.143	43.0	6.15
10 to 15 mu.	12.5 mu.	.080	8.9	.71
15 to 20 mu.	17.5 mu.	.057	6.5	.37
20 to 30 mu.	25.0 mu.	.040	16.2	.65
30 mu. to No. 325 sieve	52.5 mu.	.019	18.2	.35
No. 325 to No. 200 sieve	112.5 mu.	.009	6.2	.06
Plus No. 200 sieve	Not considered effective		1.0	.00
			Summation (equals C. E. F.)	8.29

Since the ratios of surface to mass in solids are proportional to the reciprocals of their mean diameters, it is apparent that C. E. F. is simply an expression of the ratio of effective surface to mass in the cement.

Regarding the use of a value of 7 microns as the mean effective diameter of the minus 10-micron size group, this

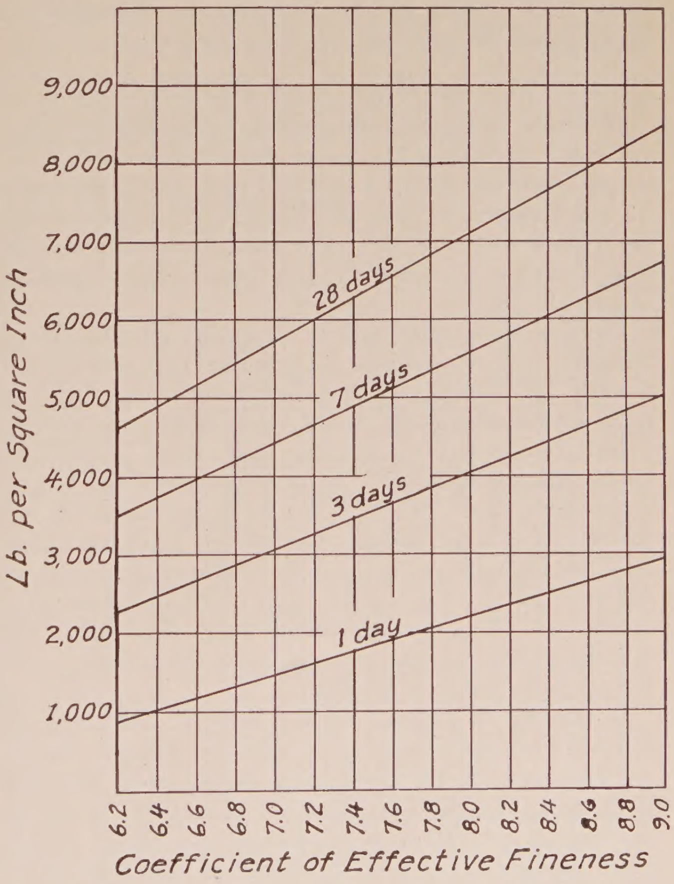

Figure 4. Relation between coefficient of effective fineness and compressive strength (Super Cement, W/C = 0.8)

is the only group in which it is considered necessary to discriminate between "effective" and "actual" particle size.

Studies carried out some years ago, under the author's direction, involved the separation of substantial quantities of pulverized clinker into groups of various particle sizes. The relative activity of these groups was then determined, activity being measured by their strength-age curves in standard sand and plastic graded sand mortars, each size group being tested individually and also in various combinations with the other groups.

Experimental Determination of Activity Values

These studies indicated clearly the relation between activity and the ratio of surface to mass in all groups coarser than 10 microns. In the case of the minus 10-micron group, however, activity values were of an order suggesting that the group had a mean effective particle diameter of 7 microns, although microscopic studies of the group indicated an actual mean particle diameter of rather less than 5 microns in most cases.

Having thus experimentally determined the "activity values" of the different size groups, and having devised an expression of effective fineness that reflected these activity values, it remained to prove the consistent significance of this expression of effective fineness by applying it to commercially ground cements.

Subsequent studies of commercially ground cements from sixteen different plants, in which "Coefficient of Effective Fineness" has been plotted against compressive strength of plastic graded sand mortar, have amply confirmed the practical significance of the preliminary studies. The verity of this statement is illustrated by Figure 4 and the previous references thereto.

Grinding Methods Must Permit Rational Grading

It should be pointed out, however, that the use of a value of 7 microns as the "mean effective diameter" of the minus 10-micron group is justified only when effectively burned clinkers of "normal" chemical composition are being dealt with, and only then when these clinkers have been ground in a manner that produces a rational grading of particle size.

Clinkers abnormally high in tricalcium silicate, or abnormally low, or systems of grinding that disturb the particle size distribution from what the author believes to be a rational grading, would result in different activity values and probably necessitate the use of a different "mean effective diameter" for the minus 10-micron group.

Similarly, if the "C. E. F." is to be applied as an expression of effective fineness to materials other than portland cement, such as pigments, for instance, the minimum effective particle size would have to be experimentally determined. Conceivably, infinity may alone limit the minimum effective size of a particle of pigment, with respect to its virtue in a paint.

In the case of portland cement, however, the author is satisfied that considerations of effective fineness should not give credit to the tremendous surface areas involved in assuming that the mean diameter of a minus 10-micron fraction is 5 microns, or in making meticulous studies based on the frequency of occurrence of particles 1, 2, 3, etc., microns in diameter, without any regard for whether a 1-micron particle is "more effectively" smaller than a 4-micron particle or not.

While C. E. F. as described in this article is based on considerations of hydraulic activity as reflected in strength, parallel observations of such qualities as plasticity, density, impermeability and resistance to chemical action have been made. These observations indicate that all of these desirable qualities are enhanced in the same general direction as the quality of strength by increasing the C. E. F. to which the cement is ground.

It is very probable, however, that the relative values of 4-micron particles as compared with 1, 2 or 3-micron particles, may be very different when "value" is determined by plasticity, density, etc., from what they are when it is determined by strength.

Unfortunately, sufficiently accurate means for measuring most of these qualities of cement, other than strength, have not yet been devised.

Other significant characteristics of portland cement that deserve consideration are those of volume change and heat evolution in the setting and hardening processes.

In both cases the author has failed to observe any evidence contradictory of the rational assumption that, with cement made from a given clinker, there will be no greater volume change or greater evolution of heat in attaining a desired strength in three days with a given concrete mix, than would be involved in taking 28 days to attain the same end by using cement ground to a lower C. E. F. from the same clinker. Such evidence as there is, points in fact, in the other direction.

The author concludes, therefore, by projecting the thought that the higher the "Coefficient of Effective Fineness" to which a portland cement is ground, the better is the product from every standpoint, provided that the manufacturer is sufficiently skilled in his art to control the behavior of his product in the warehouse, the testing laboratory and the field.

"Engineering Week" to Be Held at Chicago in June

Nineteen national engineering societies, including the American Society for Testing Materials, will hold their annual conventions in Chicago from June 26 to 30. These five days, designated as Engineering Week by the Century of Progress, will contain a general engineering program that is expected to attract and interest thousands in the profession.

The organizations, including the leading ones in the civil, mechanical, electrical and mining and metallurgical fields, will co-operate in a general program on Engineers' day, Wednesday, June 28, at the Stevens Hotel.

During this week also, the Testing Society will hold its second exhibit, in conjunction with its thirty-sixth annual meeting. Testing apparatus and machines, recording and control apparatus, laboratory equipment, measuring instruments will be on exhibit. Emphasis will be placed on the technical features of design, construction and use of apparatus and machines, adaptability to standard as well as special tests of materials, relationship to A. S. T. M. requirements for tests and apparatus, and the development of new apparatus and new tests.

A group of some twelve papers will cover the subject, "Significance of Tests of Concrete and Concrete Aggregates," as one of the features of the A. S. T. M. annual meeting.

EDITORIAL

Wasting Money on Cheap Roads

GOVERNORS and other state officials who advocate "cheap" types of construction for secondary roads, in order to build more mileage with the funds available, might find it profitable to themselves as well as the taxpayers if they were to consult the local users of secondary roads.

This has been suggested by the editor of a small-town weekly, who quotes from an article headed "Roads in a New Phase," published in a daily newspaper in the state's largest city.

The article in question describes in detail what it calls "an inexpensive surface of stone and bituminous material" employed in this "new phase" of constructing the secondary highway system of the state. These roads are praised in glowing terms as a boon to the farmer, a perennial attraction to tourists, bearers of cash from the outer world into small towns, and a relief from the heavy tax burdens.

"The above reads well," the small-town editor remarks; "but if the kind of work done in Linneus last summer is a part of that 'new phase' then we want to say it was money wasted."

A cheap road and a cheap suit of clothes are alike in one respect—they both represent money wasted.

Shaking Down the Motorist

THE federal government now enjoys a substantial revenue from the 1-cent gasoline tax and excise taxes on automobiles and accessories—a revenue considerably larger than the annual appropriations for federal-aid highways, which in recent years have averaged about $125,000,000.

It does seem that a proper sense of fair dealing would call for a continuation of appropriations at least equal to the recent average. Any other course on the part of Congress will place the national government in a class with state and municipal governments, so far as bleeding the motorist is concerned.

As a result of the policy of federal aid for highway construction, the nation has obtained a unified system of well-built highways, in place of the disconnected and indifferently constructed roads that were built prior to the inauguration of federal aid in 1916. Under the influence of the U. S. Bureau of Public Roads routes connecting all parts of the country were established, and standard types of highway construction were developed.

The nation has obtained all this in return for federal-aid appropriations not exceeding eight per cent of the total amount expended on highways.

Will Congress see to it that the motorist gets a square deal in return for the special taxes which he now pays into the federal treasury, or will it allow the national government to join state and local governments in the game of shaking down the motorist and giving him nothing in return?

A Great Annual Meeting

THE twenty-ninth annual meeting of the American Concrete Institute supplied both a surprise and an inspiration to the 310 registrants and others who attended the sessions of the convention at Chicago during the last full week of February.

In more prosperous times the annual meetings of the Institute have seen larger registrations, but never in the history of the organization have the delegates shown so keen an interest in the programs presented, nor have the sessions drawn a larger attendance. It was quite evident that those who came to the convention came for the purpose of learning and exchanging ideas.

The program of technical papers and reports was well balanced and of exceptionally high quality. The authors had intimate acquaintance with their subjects, and the ability to present them to advantage.

All things considered, the officials of the American Concrete Institute have reason to be well pleased with the twenty-ninth annual convention.

The Concrete Masonry Association

IT is no secret that the success of the annual meeting of the Concrete Masonry Association, held in Chicago on February 23, was far beyond expectations. Whether considered from the standpoint of attendance or of interest displayed, this was one of the most successful national conventions ever held by organizations representing that industry.

The nature of the program and the lively interest taken in the various subjects under discussion may be gathered from the report of the meeting, appearing in this issue of "Concrete." This issue also contains the author's abstract of one of the papers presented.

The Concrete Masonry Association is one of the most progressive organizations in the construction industry. Representing, as it does, a comparatively small group, it has achieved outstanding results in research activities that would do credit to much larger organizations. It deserves the financial support of every manufacturing unit in the industry, for the advantages to be gained from a membership greatly exceed the small sum charged for a membership.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Committee C-9 of A. S. T. M. Reports Much Progress in 1932

ONE of the most active committees representing the American Society for Testing Materials is Committee C-9 on Concrete and Concrete Aggregates. Acting through its various subcommittees, the general committee is credited with accomplishments in a number of directions.

Revisions were made in the standard tests for organic impurities in sands, the sieve analysis of aggregates and the making and testing of compression test specimens; also changes in the tentative tests for structural strength of fine aggregate and soundness tests of fine and coarse aggregates.

The revisions in the standards, which involved no fundamental changes in procedure, resulted from experience with the use of the methods and for the most part were for purposes of clarifying and amplifying statements of procedure and of bringing them into conformity with similar standards of other organizations.

A proposed method of testing concrete and concrete aggregates by freezing and thawing was presented as information because of the importance of this subject and with the hope that the summary of this work would be of assistance in guiding further investigations.

The subcommittee on ready-mixed concrete has completed the purchase specification for this material and expects to present it as a tentative standard at the next annual meeting. The specifications will cover the materials, proportioning, mixing, delivery, quality, inspection, testing and acceptance of ready-mixed concrete for all purposes.

The digest of existing data relating to permeability of concrete is expected to be completed in time for presentation in June. The committee has undertaken the development of a standard laboratory method for the determination of the efficiency of a curing material. Progress has been made in the work on the standard method of test to determine the volume changes in concrete, which it is expected will be presented at the annual meeting in June.

The organization of Committee C-12 on Mortars for Unit Masonry was completed during the year with the appointment of some 17 subcommittees to consider the various subjects comprising the comprehensive program of work.

The subcommittee on unit masonry construction practice is working on a preliminary draft of recommendations for the use of mortars in unit masonry construction, which will be submitted to the subcommittee for criticism and suggestions. At a later date, such investigations as are deemed necessary by the subcommittee will be outlined and presented to Committee C-12.

The subcommittee on efflorescence and staining is making an effort to collect all available information on efflorescence and staining, its causes and correction. A preliminary report on this work should be forthcoming at an early date.

The subcommittee on mortar aggregates has outlined a comprehensive program of work, while the subcommittee on preparation of mortars is collecting information on present practice.

Activities of Committee on Cement

DURING the year 1932 the American Society for Testing Materials Committee C-1 on Cement completed a revision of the standard methods for sampling and testing portland cement, extensive changes being made in the tolerances applying to testing apparatus together with a clarification of the text as well as the manual of cement testing. Particular attention has been given by the various subcommittees to such subjects as particle size of cement, accelerators and retarders, plastic mortar tests and the effect of temperature of cement at the time of use.

The Cement Reference Laboratory at the National Bureau of Standards, a co-operative project of the Bureau and the Society under the sponsorship of Committee C-1, has continued its efforts to promote uniformity and improvement in cement testing, and is now engaged in a third tour among the cement testing laboratories throughout the country.

Determining Bar Areas by Weight-Area Method

RESEARCH Paper No. 486, of the National Bureau of Standards, Washington, D. C., reports tests conducted by the Bureau with the view of comparing various methods employed for determining the cross-sectional areas of deformed steel reinforcing bars.

The conclusions drawn from the tests were (1) that the weight-area method is probably the most accurate means of determining the cross-sectional area, and (2) that the difference in test results between rolled sections and those from which the deformations have been machined is so small that it may be ignored. These results serve to validate the action previously taken by the A. S. T. M. looking toward similar changes in reinforcing bar specifications.

Test Methods for Soundness and Consistency

THE following methods covering soundness tests for fine and coarse aggregates and consistency tests for concrete have been issued by the American Society for Testing Materials as tentative standards:

Method of Test for Soundness of Fine Aggregates by Use of Sodium Sulphate (C88-32T).

Method of Test for Soundness of Coarse Aggregates by Use of Sodium Sulphate (C89-32T).

Method of Test for Consistency of Portland Cement Concrete (D138-32T).

Precast Concrete Joists Called Key to Firesafe Homes

Big Field for Products Market—Initial Equipment Not Expensive — Light-Weight Aggregates Overcome Objections to Weight—Long List of Patents

By E. W. DIENHART
Portland Cement Association, Chicago, Ill.

PRECAST concrete floor joists is a subject of very special interest at this time because it promises to open up a new and profitable line of work for concrete products manufacturers. Developing business in this field opens a wide market since, because of their economy, concrete joists will be able to compete with wood joists not only in buildings with masonry walls but also for first floors in wood frame structures. One of the most favorable aspects of this subject is that basically, no radical departure from existing construction methods is involved.

Where the Market Lies

The practical details of the building methods applied to concrete joists have been established and known for 30 years.

The market for low-cost, light-weight concrete floor construction should be limited to floors for structures having relatively light live loads—for example, live loads of about 60 lb. per sq. ft.

Concentration of effort behind the sale of concrete floors for residences is particularly advantageous at this time because the concrete floor is a vital necessity to the "Fireproof House." In fact we consider the concrete floor to be "The Key to Firesafe Homes."

Our efforts must further be concentrated on methods through which it will be possible to build concrete floors at a cost that is directly comparable with the cost of wood floors.

With the development of the concrete floor and its general acceptance by home builders and buyers, we can definitely forecast that before long the public will see that the wood floor finish is not as economical, nor as attractive, as finishes that may be applied directly to the concrete slab.

An Old Subject

In 1912, Ernest L. Ransome published a book, "Reinforced Concrete Buildings," in which he states: "The idea of molding reinforced concrete members separately and afterward erecting them in place appears to be almost as old as the art itself. . . .

"In 1898, patent No. 606,696 was issued to G. B. Waite for a beam construction, the sole object of which is to provide members adapted to be molded in advance and erected in place after hardening. The individual sections are made of I-shape and reinforced in top and bottom, or in the bottom only. Shear members of various forms are used in the beam webs."

Investigators have attacked this problem of obtaining more economical floor construction in various ways. The direction of thought is well illustrated in the following list of patents which are enumerated in the order of the patent date:

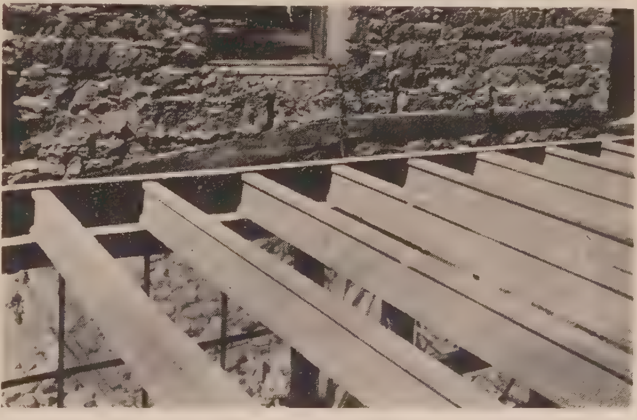

Figure 1. Typical precast reinforced concrete joists used in fireproof floor construction

Patent No.	*Date Issued*	*Patentee*	*Character of Precast Unit*
684,258	Oct. 8, 1901	P. H. Jackson	Composite beam
694,577	Mar. 4, 1902	E. L. Ransome	Rectangular beam
735,920	Aug. 11, 1903	F. Visintini	I-beam
921,626	May 11, 1909	W. Raster	Inverted U-shape
992,994	May 23, 1911	H. L. Smith	I-beam
1,081,373	Dec. 16, 1913	H. H. Du Pont	Composite beam
1,159,526	Nov. 9, 1915	J. J. Moran	Web and flanges
1,212,759	Jan. 16, 1917	Frost & Rings	Composite beam
1,320,072	Oct. 28, 1919	E. McL. Long	Web and flanges
1,538,293	May 19, 1925	P. B. Loyeau	Double T-shape
1,673,628	June 12, 1928	L. C. Krummel	Channeled girder
1,745,880	Feb. 4, 1930	J. Winston	T-shape
1.764,134	June 17, 1930	H. F. Young	I-beam
1,871,318	Aug. 9, 1932	R. F. Greenwood	T-shape

In addition, the "Isteg" system, in general use in Europe and now being introduced in the United States, employs the same elements of design proposed by Ransome, except that no metal ties are used to join the joist and the slab.

John W. Cooke & Son also employ a system in England similar to the "Isteg," but in which filler tile provide a ceiling. Concrete Limited, another English concern, pro-

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Author's abstract of more detailed paper delivered before annual meeting of Concrete Masonry Association at Chicago, Ill., Feb. 23, 1933.

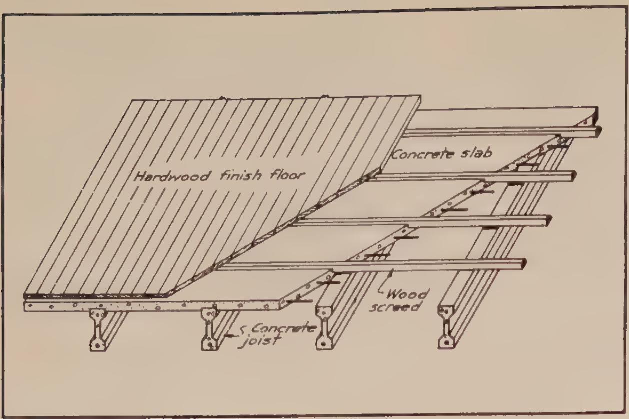


Figure 2. Detail showing job-placed concrete slab and wood floor finish supported on precast joists

duces a precast floor unit similar to precast industrial roof slabs widely used in the United States.

Details of Older Types

A review of the claims made for each of the systems covered by these patents indicates that E. L. Ransome, in 1902, had the modern concept of the requirements of low-cost concrete floor construction. He approaches the problem from the standpoint of providing a precast concrete joist, the joists serving as supports for slab forms, a concrete slab being placed over the joists. He provides a metal coil to obtain closer bond between the joist and the slab. His patent contemplates other means of improving this bond.

A similar method of bonding the slab to the joist is used by H. H. Du Pont, where the stirrup or shear bars extend above the joist top for the purpose of engaging the concrete slab.

A wide variety of concrete section shapes has been employed. Ransome uses a rectangular section, while others used I, T and H sections.

Provision for the passage of service connections, particularly for heating and electric wiring, through the joists is frequently important. The system of Visintini, W. Raster, P. B. Loyeau and H. F. Young, are particularly adapted to this purpose.

Points to Be Kept in Mind

The system for any individual concrete products manufacturer to consider will depend, to a great extent, on his own reaction to the merits of a particular design which his study of the subject indicates best suited to the purpose intended and to his manufacturing facilities.

For the purpose of determining the factors to be considered in selecting a specific type of joist, the following suggestions are offered:

1. The joist should be light in weight so that it may be easily placed on the job, easily handled in the factory, and so that it will add the minimum dead weight to the floor.
2. The joist design should be attractive in order to present a pleasing appearance underneath when left exposed.
3. The joist should effect a satisfactory bond with the top slab in order to take advantage of the compressive strength of the slab concrete.
4. Provision should be made for the passage of service connections through the joist.

Special consideration should be given to the use of light-weight aggregate, because weight reductions made possible through the use of these aggregates assume outstanding importance.

With regard to provisions for passage of pipes, the manufacturer has the choice of casting openings in the joist or inserting plugs which may be removed on the job when necessary.

Initial Equipment Needed

It seems self-evident that the capital outlay necessary for initial manufacturing equipment should be kept at a minimum. With that prime objective in view, and with adequate consideration of production costs, I firmly believe that the best method of approach to the manufacturing problem is through the medium of gang molds.

Where a substantial market for precast concrete joists is indicated, manufacturers should give serious consideration to the use of equipment designed for volume production. During the initial introductory period in a given market, manufacturers should not lose sight of the fact that it may prove more economical, when all costs are considered, to bear a slightly higher labor cost which might result when a simple set of molds are used. Costs for interest and depreciation might well exceed any excess costs for production labor.

Good Results at Kalamazoo

Consideration of this subject would not be complete without specific mention of the progress made by the Kalamazoo Haydite Tile Co., of Kalamazoo, Mich., of which the manager is Val Berry. The aggressive sales efforts of this company have firmly established the precast concrete joist and concrete floors as standard methods of construction. To their credit are many fine projects, each attesting to the merit of this type of construction.

This firm manufactures "Lith-I-Bar" joists, employing one of the large volume production machines of the same name.

Cederstrom's Plan to Accelerate Public Works Construction

Hjalmar Cederstrom, a noted architect of Stockholm, Sweden, is engaged in the development of an international plan for the solution of the unemployment problem. He is known as an advocate of an active policy of public works to be carried on steadily, and in times like those of today, greatly accelerated. He specifies two essentials to a public works program: (1) It must provide work for the unemployed. (2) It must provide a future means of livelihood for certain persons by means of that work.

He is emphatically against any form of "dole" but points out the grave dangers which will result from sudden or forced economies.

Mr. Cederstrom is charged by the International Labor Office at Geneva, attached to the League of Nations, with drawing up an international scheme for relieving unemployment which that office will print and send to all governments. For the financial questions involved in this problem, Mr. Cederstrom is to co-operate with the International Bank of Settlements at Basel. To further his plan an International Association of Engineers has been founded with one branch in Berlin and others in Paris and London.

Place Truck-Mixed Highway Concrete With Mechanical Spreader

Spreads Concrete Evenly Without Separation of Aggregates — Mixed Batches Delivered by Side-Dump Trucks from Adjacent Lane

A MECHANICAL concrete spreader that received concrete from side-dump truck mixers of 5 cu. yd. capacity, then conveyed the concrete on a short belt to the center of the machine, where it was discharged to the subgrade and spread by means of a right and left hand spiral conveyor, was the outstanding feature of a large highway construction project in Massachusetts in the latter part of 1932.

Six-Lane Road of Sheet Concrete

This project, on a 6½ mile stretch of the Worcester-Boston Pike, consisted of six 10-ft. lanes and required nearly 50,000 cu. yd. of concrete. The pavement is the 2-course "sheet concrete" type, consisting of a 7-in. concrete base, then a sheet of burlap, then a 2-in. layer of a dense, rich mixture of concrete on top of the burlap.

A machine was used to carry the burlap roll, and since this machine was of necessity operating between the two points where concrete was being deposited, two concrete spreaders were needed. Thus one spreader placed the 7-in. base ahead of the burlap machine, and the other operated on the top course back of the machine.

Mechanical spreader receiving and placing 5-yd. batch of truck-mixed concrete on Massachusetts road work

Operation of Mechanical Spreader

Each mechanical concrete spreader took a 5-yd. batch of truck-mixed concrete in about 1½ minutes. On the 7-in. base course the forward speed of the spreader ranged between 18 and 24 ft. per minute, while on the 2-in. top course the forward speed was from 40 to 50 ft. per minute. The reverse speed of the spreaders is from 50 to 75 ft. per minute.

The actual time required for discharging a truck mixer averaged 1¼ minutes. The spreader was operated by a crew of two men, an operator and a helper. As the truck mixer arrived on the subgrade of the adjoining lane, to a position alongside the spreader, the helper stepped from the spreader to the mixer and controlled the rate of discharge. The truck traveled slowly along with the spreader as the placing proceeded.

The Truck Mixers

The truck mixers employed were capable of discharging to either side of the truck. The mechanical spreaders, likewise, are designed to receive concrete from either side. On the Massachusetts contract, however, the work was planned so that the discharge from the truck was always on the driver's side.

The concrete in the trucks was mixed a minimum of 40 revolutions of the drum, requiring about 4 minutes.

The central batching plant from which the trucks operated was located near the midway point of the project, about half a mile from the road under construction. Ten trucks was the greatest number employed at one time. The trucks traveled at a speed of 15 miles an hour on the subgrade and 20 miles on the finished slab.

Acknowledgment

The mechanical spreader here described was manufactured by the Jaeger Machine Company. The 5-yd. truck mixers, likewise, are of Jaeger manufacture, mounted on special six-wheel Mack trucks.

Campaign for Remodeling of Property Succeeds in Philadelphia

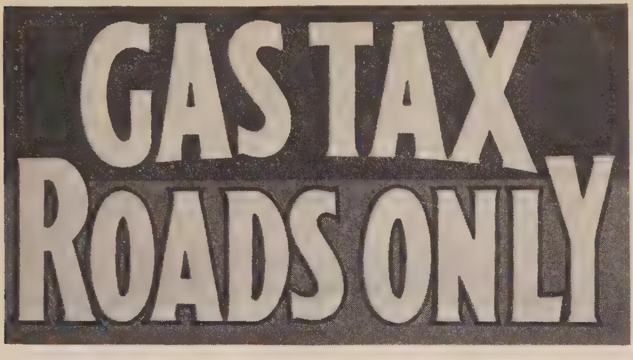
Residents of Philadelphia will spend over $15,000,000 in property remodeling and repairs within the next six months, as a result of the "Renovate Philadelphia" campaign now being conducted under the leadership of local business and professional men and women and labor leaders. Citizens were urged to make needed property repairs and improvements as an effective means of relieving unemployment, stimulating business, and stabilizing property values.

Initiated by the Philadelphia Federation of the Construction Industry, the movement obtained the active assistance of more than a thousand trade, civic, community, and religious organizations. The metropolitan district of Philadelphia, including suburban areas, was subdivided into 22 geographic divisions, to which 7,000 voluntary workers were assigned from interested organizations, under the guidance of leaders designated as colonels and captains. A house-to-house as well as a business property canvass was conducted by those trained workers to cover practically every building in the city. The property owner was asked to indicate on a pledge card the estimated amount of money which he felt he could reasonably spend for needed repairing and modernizing to his home or business property.

More complete details regarding this and other similar campaigns may be obtained, on request, from the Division of Building and Housing, U. S. Bureau of Standards, Washington, D. C.

Stickers Build Sentiment Against Diversion of Gas Tax

Printed in appropriate colors and carrying the timely message "Use GAS TAX for ROADS ONLY," windshield stickers are beginning to be seen in large numbers on the highways of various states. They are already being distributed by the Marion County (Indiana) Motor Club, the Chicago Motor Club, the Illinois Construction Council, and organizations in Rhode Island and other New England states.



The plan to distribute these stickers was undertaken at the urgent request of state and county highway departments and the various industries who are directly concerned with highway funds.

These windshield stickers, with white letters on a red and blue background, express the rapidly growing sentiment against inequitable diversion of highway funds. A plan to distribute them was undertaken by the Ray Press, Chicago, Illinois, at the urgent request of car owners and the many industries having direct interest in road building.

Standing Committees of A. S. T. M. to Hold Meetings

The standing committees of the American Society for Testing Materials will hold their annual Spring group committee meetings in New York, beginning Monday, March 6, and extending through Friday, March 10. In conjunction with these is the fourth regional meeting, sponsored by the Society, which will be held on Wednesday, March 8. All meetings will be in the Hotel New Yorker.

Committee C-9 on Concrete and Concrete Aggregates, and Committee C-10 on Hollow Masonry Building Units, are among the committees scheduled to hold sessions during these meetings.

Coming Conventions

June 21-24—American Society of Agricultural Engineers, 27th annual meeting. Purdue University, Lafayette, Indiana.

June 26-30—American Society for Testing Materials, annual meeting. Stevens Hotel, Chicago, Ill.

June 26-July 1—American Society of Civil Engineers, annual convention. Chicago, Ill.

Levee Is Built Up With Broken Concrete

Concrete, broken into pieces when torn out of sidewalks and curbing as Plumas Street was widened, is being used as a fill at the base of the Feather River levee, just north of the Southern Pacific bridge, on the Yuba City bank, says a recent article in the Yuba City (Calif.) *Independent.*

Piling has been set up to retard the concrete, thus providing a breaker against the current that has recently eddied at that point, taking away much of the sandy soil on a shoulder of the main levee.

Thinks Light-Weight Concrete Is Most Important Subject

W. A. Collings Believes Construction Industry Needs Better Appreciation of Value of Light Weight

Editor, CONCRETE:

I subscribe for CONCRETE because of the valuable and informative articles you publish on the important subject of light-weight aggregate for concrete. After 30 years of experience in concrete work of all kinds, I feel sure that light-weight concrete is the most important of the "new things" before the construction world today. The space you devote to this subject shows that CONCRETE is "close up to the band" in the procession of construction progress.

If you will allow me a suggestion, I believe it would be a good idea to publish a regular monthly column on "Light-Weight Aggregate," containing news and ideas coming up in this most important field. I am glad to say that the Portland Cement Association is greatly interested in light-weight concrete aggregate, and out here on the Pacific Coast that organization is keeping in touch with developments in an admirable manner. It might be of interest to mention that light-weight aggregate concrete is specified for the floor of the Golden Gate bridge now in process of building at San Francisco.

In my opinion, as soon as construction work regains some measure of its former activity, light-weight aggregate and concrete and concrete products made from it will push right to the front.

W. A. COLLINGS
Concrete Engineering

937 Seventh Street,
Santa Monica, Calif.
January 9, 1933.

Proportioning, Mixing and Placing of Concrete Piers

Portland Bridge Structure Utilizes Transit-Mixed Concrete—Careful Control of Quality—Use Aggregates Up to Three-Inch Size

By W. A. SCOTT
Portland, Oregon

THE construction of the sixteen concrete piers for the St. Johns bridge, across the Willamette River, Portland, Oregon, presents a striking alignment of concrete supports for 3,604 lin. ft. of steel superstructure.

The two river piers support the steel towers that carry the cables for the 1,207-ft. suspension span over the river. Each of these is at the water's edge, a few feet inside the harbor line. The others are land piers of Gothic arch design, except one, which has a half-circle arch between the supporting shafts.

Decorative Features of Pier Facing

In the construction of each of the river piers, the facing above water level was built on a batter 15/16 of an inch in 12 in., up to the 6-ft. coping. The facing below the coping was finished with rusticated joints on 4-ft. centers as relief features. The pier shafts are set back to form pedestals for steel tower columns. Each pedestal has a concave architectural effect at the pointed end and is embossed with three shields. The body of the exterior wall has rusticated joints on 2-ft. centers, and all above a given level are bush-hammered.

Aggregates and Concrete Mixes

The concrete for land-pier foundations consisted of 1 part cement, 2.6 parts sand and 3.4 parts gravel of 3-in. minus. This mix required 5.64 sacks of cement per cubic yard of concrete, using 6.8 gals. of water per sack of cement.

No. 2 mix, for concrete used in the main bodies of the land piers and the two river piers, comprised 1 part cement, 2.2 parts sand and 2.8 parts of 3-in. gravel. A cubic yard of concrete for this mix carried 6.77 sacks of cement. In this richer mix there was used 5.6 gals. water per sack of cement. In both mixes quantities of water specified included free water adhering to the particles of aggregates. Willamette River gravel, washed and sized for grades from 3-in. to ¼-in., was used in both mixes. The classification was such that 63 per cent would pass a 1½-in. screen. In weight, this graded gravel ran about 105 lb. per cu. ft., damp, loose material.

The sand used in both mixes was taken from the bars and banks of the Columbia River. This has a fineness modulus of 3.15, a measure of sand grading. Only about 1 per cent would pass a 100-mesh screen. Its weight is about 82 lb. per cu. ft., including 7 per cent moisture.

Mixing and Delivering Ready-Mixed Concrete

The bridge piers, approach abutments, roadway deck and curbing required close to 70,000 cu. yd. of concrete, of which about 43,000 cu. yd. was mixed at the proportioning plant of Swigert, Hart & Yett Co., Portland, and delivered in that concern's 3-yd. transit mixers to the several jobs.

Concrete of high quality was placed by transit mixers in piers of St. John's bridge across the Willamette River, Portland, Oregon

An aggregate and cement storage and proportioning plant was established by the Swigert, Hart & Yett Co. at a dock on the east bank of the river in the vicinity of the bridge site. The sand and gravel, received there in barges, were transferred to the dock, where they were placed separately in a rick about 200 ft. long. This stockpile was undercut by a belt conveyor by which the grades of aggregate were delivered separately to an 80-ft. bucket elevator, the latter discharging through spouts into storage bins. The specified proportions of aggregates and cement, by weight, were then drawn by gravity into the batch chute. Thus, while material for a 3-yd. batch of concrete was being passed gradually from the chute to the transit mixer, the latter was slowly revolved for making a dry mix. The driver of the transit mixer truck, on approaching some one of the concrete placing jobs, ¼ to ¾ mile away, would draw down into the mixer the specified quantity of water for a 3-yd. batch, then revolve the mixer the requisite time to complete the wet mix. Then the truck was promptly moved into position for discharging the batch at the job.

The plant referred to has the capacity for proportioning, mixing and delivering 60 cu. yd. of concrete per hour. In the course of this work the company had a maximum of 12 transit mixers in use, serving as many as five concreting jobs on this project at the same time.

Concrete House Construction Move Waits Education

Karl Offer Believes Energetic National Campaign Will Get Results

Editor, CONCRETE:

I take pleasure in attaching a page from a San Francisco daily paper, in which you will find a reprint of the article in your December issue headed "Build Reinforced Concrete Houses with Standard Metal Forms." Due credit is given.

I believe that by an energetic, aggressive campaign of education through newspapers and national magazines the American people can be induced to build concrete homes. With only limited appropriations available for promotional work, and with our activities extending only over the local area, we have created much interest in our method of building reinforced concrete houses. Hardly a day passes now that does not bring us an inquiry, from some prominent architect, home builder or contractor, concerning our system of steel form construction.

At first we had to overcome considerable opposition from some architects, who advised their clients against the idea of building concrete homes. We felt that this opposition was due mainly to lack of information concerning our construction procedure, perhaps coupled with the natural human tendency to resist a departure from the established way of doing things. We were able to demonstrate to their satisfaction that our method of steel form construction involves no greater difficulty than older methods, and that the construction cost is not higher than properly built wood frame and stucco.

I would like to see publications such as yours, and organizations like the Portland Cement Association, push concrete house construction to the limit.

KARL OFFER.
President-Manager,
American Pacific Company

San Francisco, Calif.
January 5, 1933.

Calcium Chloride Association Formed; Office at Detroit

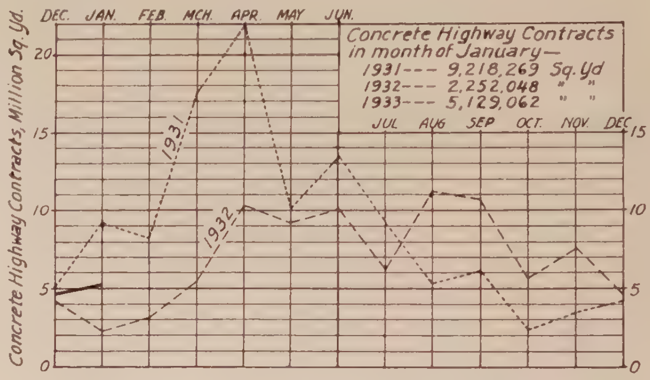
Organization of the Calcium Chloride Association, with offices at 4200 Penobscot Building, Detroit, Mich., was announced on February 2. Members include the Solvay Sales Corp., the Dow Chemical Co., the Michigan Alkali Co., and the Columbia Alkali Corp.

The association also announced the appointment of Ray A. Giddings, of Barberton, Ohio, as secretary. Mr. Giddings formerly was manager of special product sales for the Columbia Alkali Corp. Previously for a number of years he was with the Minnesota state highway department. He will supervise the association activities including advertising, research and promotion of the various uses of calcium chloride.

The Calcium Chloride Association succeeds the Calcium Chloride Publicity Committee, formed by the same interests in 1928 to promote the interests of the calcium chloride industry.

January Highway Awards Are Twice the Figure for Year Ago

Highway departments made a good start in January in the matter of concrete road contracts, the awards for the month having totalled 5,129,062 sq. yd., according to figures compiled by the highways bureau of the Portland Cement Association.



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This is more than twice the yardage awarded in January of last year, when 2,252,048 sq. yd. were placed under contract.

PERSONAL

Dean Arthur N. Johnson of the College of Engineering, University of Maryland, and a pioneer in highway engineering, was presented the George S. Bartlett award which is given each year by road groups as a recognition of outstanding highway service. The award was bestowed at the banquet of the Highway and Building Congress in Detroit during January.

The award is a bronze plaque on which is carried a likeness of Mr. Bartlett who has also devoted his life to the furtherance of good highways. It is awarded jointly by the Highway Research Board, the American Association of State Highway Officials and the American Road Builders' Association. Last year the award was presented to Thomas H. MacDonald, chief of the Bureau of Public Roads.

Dean Johnson is the only surviving member of the first class in highway engineering to be conducted in the United States. This class was started in 1893 at Harvard, from which Dean Johnson graduated in 1894. Shortly after becoming state highway engineer of Maryland in 1898, Dean Johnson mapped out a highway system which is substantially the main state highway system of today.

HOW TO DO IT

✦ Questions and Answers ✦
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Procedure for Surface-Drying Concrete Aggregates

In making tests of concrete aggregates it is necessary to surface-dry the material. As I understand this process, it is not permissible to heat the aggregates, for in that event the absorbed moisture within the individual grains of the aggregate would be driven off, which would result in the weight of the sample being less than surface-dry.

We have made a search of engineering literature in an effort to find some method of procedure that is considered standard in the matter of surface-drying aggregates, but we can find nothing on the subject. We would be pleased to learn what standard method is in use.—C. J. S., Rio de Janeiro, Brazil.

The question raised by C. J. S. was referred to H. F. Gonnerman, manager of the research laboratory, Portland Cement Association, Chicago, Ill., who replies that he knows of no generally accepted standard method of surface-drying concrete aggregates. He refers, however, to the method for surface-drying fine aggregates as given by W. M. Dunagan in his Manual of Control Tests for Portland Cement Concrete. The following is quoted from that manual:

> Obtain a representative sample of the material to be used (5 lb. or more). Spread it out on a flat surface and air-dry it until the surface moisture has evaporated and the sample will flow freely from a dry trowel or metal surface.

For the surface-drying of coarse aggregates this same authority adopts the following procedure:

> Wipe the individual particles surface-dry with a towel and weigh out exactly 2,000 grams in air. A specially designed centrifuge has been found efficient in bringing the material to this surface-dry condition.

Mr. Gonnerman further refers the inquirer to Appendix IV and V of the 1931 Report of Committee C-9 of the American Society for Testing Materials, and to a paper by W. R. Johnson comparing methods of determining moisture in sands, on page 261 of the *Proceedings* of the American Concrete Institute for 1929.

Cinders for Concrete Building Block and Tile

We are considering the addition of cinder concrete block and tile to our present line of concrete products.

What can you tell us regarding the character of cinders that are considered suitable, and what strength is generally required?—A. C. B., Bluefield, W. Va.

Cinders have been used extensively for this purpose, but the blockmaker must be careful to see that the cinders being used are of good quality. Usually the cinders obtained from high-temperature power plants are satisfactory. Those from locomotive boilers are not considered satisfactory for the reason that they are likely to be coated with soot. Cinders obtained from house or apartment boilers are not usually satisfactory for the reason that they contain too much unburned material.

The Underwriters' Laboratories specifications for cinders to be used in concrete building units will be found on page 42 of the July (1930) issue of CONCRETE.

The advantages of cinder concrete units are found in their light weight and in the fact that they provide a good key for stucco and plaster.

Building regulations in general require a strength of about 700 lb. per sq. in. for load-bearing cinder concrete building units, considering the entire area of the unit, hollow spaces included.

Beam Strength of Concrete in Road Slabs

It is my recollection that several years ago an article or series of articles appearing in CONCRETE contained extensive data on the flexural strength of concrete used in highway construction work.

We are unable to locate the data, and would appreciate information as to when the article or articles were published.—J. A. C., Chicago, Ill.

It is quite probable that the article to which you refer was the last of a series of three by Paul E. Kressly, consulting engineer, Los Angeles, Calif., which appeared on pages 35-36 of the February (1929) issue of CONCRETE.

The article contains seven charts giving the results of a number of beam tests to determine the flexural strength of concrete. The variables in the tests included (1) size and grading of mixed aggregate, (2) quantity of cement in the mixture, (3) maximum permissible fineness moduli, (4) sand of varying fineness moduli, (5) age of concrete, (6) gravel of varying fineness moduli, and (7) varying water-cement ratios.

Manufacture of Concrete Building Units

It is my impression that one of the federal government bureaus has published a book on the manufacture of concrete block. Can you give me a reference to such a book, if one was published?—E. R. C., Tacoma, Wash.

Reference to such a publication appears on page 48 of the July (1930) issue of CONCRETE. It is a 49-page illustrated booklet, published as Circular No. 304 of the Bureau of Standards, under the title of "Properties and Manufacture of Concrete Building Units."

Copies may be obtained at 20 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

New Books and Pamphlets

Concrete Masonry Walls

Strength and Stability of Concrete Masonry Walls, by Frank E. Richart, Robert B. B. Moorman and Paul M. Woodworth, has been issued under date of January, 1933, as Bulletin No. 251, by the engineering experiment station of the University of Illinois.

The investigation reported in Bulletin No. 251 was designed to determine what factors influence masonry strength, and to develop further information regarding the essential properties to be specified for hollow concrete building units.

The major part of the investigation was carried on from January to May, 1931, at the materials testing laboratory of the university, in co-operation with the Concrete Masonry Association and the Portland Cement Association. A second group of tests, reported in Bulletin No. 251, was conducted in May and June, 1931, in co-operation with the Western Brick Company.

A. C. I. Column Tests

Third and Fourth Progress Reports on Column Tests at Lehigh University. By the late Willis A. Slater and Inge Lyse. Published as Circular No. 81 by the Institute of Research, Lehigh University, Bethlehem, Pa. Paper cover, 38 pages, 6 by 9 in. Numerous tables and diagrams.

The tests reported in this bulletin are a part of the investigation of full-size reinforced concrete columns inaugurated several years ago by the American Concrete Institute, under the direction of Committee 105. The list price of this bulletin is 20 cents, though a limited number are available for free distribution.

McGraw-Hill Book on Technocracy

What Is Technocracy? By Allen Raymond, staff writer on the *New York Herald Tribune*. Published by the McGraw-Hill Book Co., New York. Cloth binding, 180 pages, 5 by 7½ in. Price $1.50.

The stir created by the sudden appearance in the public press of a word that was a stranger to the public may have left some of our readers with rather hazy ideas about technocracy.

This book brings to the reader the realization that technocracy is only a comparatively new name for an old subject. It explains the ideas of technocracy, its background and the sources of its theory. It is not an economist's appraisal of the subject, but a straightforward record of essential facts, including criticisms based on the weak points of the theory.

Planning the City of Washington

Planning and Building the City of Washington. Edited by Frederick H. Newell. Published by Ransdell, Incorporated, Washington, D. C., for the Washington Society of Engineers. Cloth binding, 254 pages, 5¼ by 8 in. Illustrated with 82 halftones, 8 maps and 5 charts.

This book was officially authorized by the Washington Society of Engineers and prepared under the supervision and direction of the society. It contains a detailed account of the planning and construction of the city, the various phases of the work being described and illustrated by distinguished architects and engineers who have helped in its designing and development.

ORGANIZATIONS

American Association of State Highway Officials; W. C. Markham, Executive Secretary, 1222-24 National Press Building, Washington, D. C.

American Concrete Institute; Harvey Whipple, Secretary, 641 New Center Building, Detroit, Mich.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, National Press Building, Washington, D. C.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 West Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa. Annual meeting, June 26-30, Stevens Hotel, Chicago, Ill.

Associated General Contractors of America; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Masonry Association; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wis.

Concrete Reinforcing Steel Institute; R. W. Johnson, Secretary, 333 North Michigan Ave., Chicago, Ill.

Engineering Institute of Canada; 2050 Mansfield St., Montreal, Quebec.

Highway Research Board; Roy W. Crum, Director, 2101 Constitution Ave., Washington, D. C.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Crushed Stone Association; J. R. Boyd, Secretary, 1735 14th Street, N. W., Washington, D. C.

National Engineering Inspection Association; B. H. Witherspoon, Secretary, P. O. Box 1115, Pittsburgh, Pa.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; V. P. Ahearn, Secretary, 545 Munsey Bldg., Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 545 Munsey Bldg., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 1449 Leader Bldg., Cleveland, Ohio.

National Terrazzo and Mosaic Association; U. F. Durner, Secretary, 815 West St. Paul Ave., Milwaukee, Wis.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Portland Cement Association; Edward J. Mehren, President; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary; Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

Wire Reinforcement Institute; R. D. Bradbury, Director, National Press Bldg., Washington, D. C.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wis.

Oscillated Face on Cinder Unit

Products Men See Creation of Textured Waterproof Face on Ordinary Straub Block

A COMPLETE change in the method of facing concrete building units is predicted by F. J. Straub.

On February 9, with the thermometer hovering around 10 below zero, a group of manufacturers of concrete products and concrete products machinery assembled at the plant of the Multiplex Concrete Machinery Co., Elmore, Ohio, to witness a demonstration. Mr. Straub had called the meeting, and his call was so persuasive that only two absentees were reported, in spite of snow drifts and sub-zero temperatures.

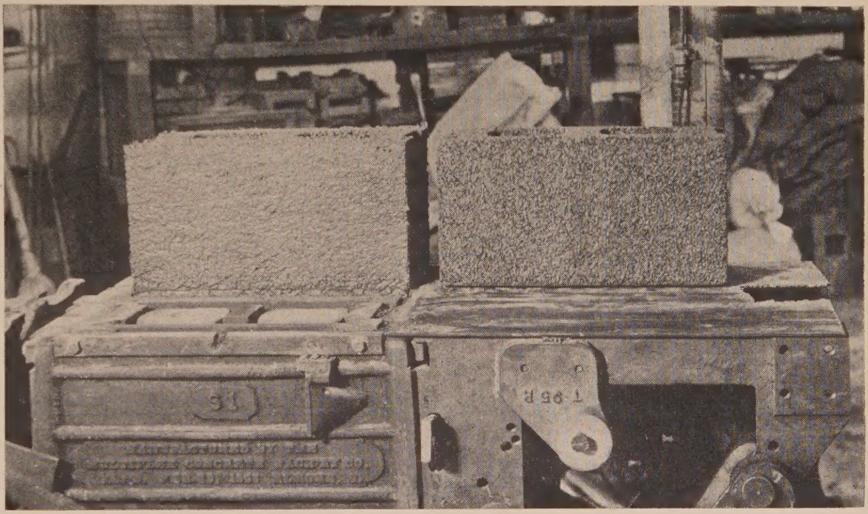
Much to the surprise of the visitors—for some had their fingers crossed—they saw the making of a cinder concrete block that was well textured and waterproof, on a machine attachment made by Multiplex in co-operation with Mr. Straub. The feat was performed without resort to magic, and before the eyes of believers and doubters alike.

Here, at last, was a cinder block with one face suitable for either exterior or interior finish, the remaining part of the unit maintaining its insulating properties, as before.

This seemingly magic feat was performed on a machine fitted with a plate that contacts one face of the unit with an oscillating motion, causing that face to become dense and waterproof. The mechanical attachment was fitted on a standard model machine. Examination of the newly made unit, shown at the left in the illustration, proved it to be a perfect cinder unit specimen, but finished with a waterproof face on the side toward the camera. The unit at the right in the illustration was made from the same batch of concrete as the other, but without the oscillating treatment. The picture shows the difference in texture.

Next the visitors were shown a cured unit which had been broken in two. Lamp chimneys sealed at the base had been placed on each half of the unit, one on the oscillated side and one on the opposite, or common, side. Water had been standing in the glass on the oscillated side for 48 hours, but none had passed through. On the other side a glass of water was absorbed in a few minutes. Again the few remaining doubters looked for a magic powder, but found no trace.

Mr. Straub believes this new method has almost unlimited possibilities. Blocks of various colors and textures can be made. Marketing plans will be made public in the near future.



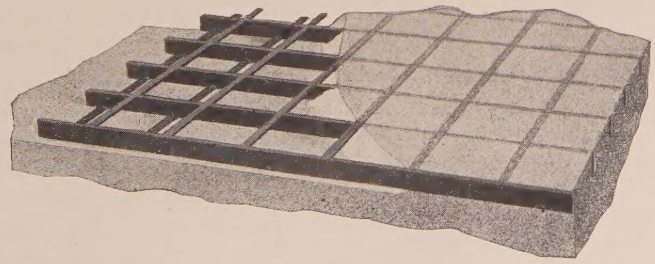
On the left, the new oscillated cinder concrete unit. On the right, a unit without the oscillated face

New Equipment and Materials

Steel Liner Plate Design and Use

Truscon steel liner plates are manufactured in three types, according to engineering notes contained in Data Book No. 5 of the Truscon Steel Co., Cleveland, Ohio. Elements of each type are shown in tables.

"... with smooth surfaces for steel concrete form purposes, or for use in caisson work where it is necessary to reduce skin friction to the minimum; with stiffening panels formed 'in' for use where it is necessary to reduce the volume of concrete lining to a minimum; and with stiffening panels formed 'out,' which shape provides the highest section modulus and consequently greatest strength and rigidity," according to the booklet.



Improved Truck Models with New Engine Available

Following the recent announcement of a new, light-duty, truck-built engine designed for greater power, sustained torque delivery and economy, the General Motors Truck Co. is now presenting two improved truck models equipped with this motor. The improved models are the T-18, of 1½ to 2 tons capacity, and the T-23, the 2-3 ton job.

With the development of the engine, known as "221" because of its cubic inch displacement, and the two improved chassis, the General Motors Truck Co. now has a balanced line of truck-built, commercial vehicles ideally graduated in power output and torque delivery, and all with valve-in-head engines of uniform design, it is stated.

These, together with the G. M. C. trailer line, enable the General Motors Truck Co. to offer a complete line of commercial vehicles ranging in capacity from 1½ to 20 tons, it is stated.

Lightness and Speed Features of New Portable Hammer

Model "X" portable hammer, manufactured and guaranteed by the Concrete Surfacing Machinery Co., Cincinnati, Ohio, is adapted for drilling, chipping, bush hammering and bull pointing. The hammer is supplied either as a complete machine, with power unit, or as an attachment for Berg concrete surfacers and finishers.

The hammer is said to be the lightest and fastest mechanical unit on the market, and to be impossible to overload or stall it. The drill chuck is so designed that only a maximum blow can be delivered by it.

The flexible shaft, connecting the hammer with the power unit, absorbs all the shocks, thereby saving unnecessary wear and tear on the motor, the manufacturer states.

The chuck and two star drills are furnished as standard equipment with the hammer.

Improved Subgrade Felt Brought Out by Philip Carey

A light, tough, strong waterproof felt, to be laid on the subgrade in concrete paving work to prevent loss of water from the concrete, is one of the new products of The Philip Carey Company, Cincinnati, Ohio.

The new felt, sold under the trade name of Carey Elastite subgrade felt, weighs 42 lb. per 1,000 sq. ft. It is supplied in rolls containing 1,000 sq. ft. each, regardless of width, which ranges from 38 to 46½ in. in the standard sizes. Special widths can be supplied at no extra cost.

Strips of felt are lapped 4 in. On this basis, where the 46½-in. width is used, the total quantity of felt required is 1,940 sq. ft. per 100 lin. ft. of 18-ft. road.

The use of this felt, it is claimed, not only prevents mixing water from being absorbed by the subgrade, but it reduces the friction between the slab and the subgrade.

The methods of application of this new felt are described and illustrated in a folder recently issued by The Philip Carey Company. Standard specifications for its use in highway work are included.

About the Makers of Equipment and Materials

Industrial Literature

Pumpcrete Folder

For the first time in the United States the *Pumpcrete* system of concrete delivery is described in printed literature, according to the *Chain Belt Co.*, Milwaukee, Wis.

The latter is now distributing a new 6-page folder entitled *"Concrete by Pipeline,"* which shows the use of the system on a number of jobs.

Engineering Achievements

A limited edition of *Engineering Achievements 1932*, a publication prepared annually, has been distributed by the *Westinghouse Electric and Mfg. Co.*, East Pittsburgh, Pa.

Innumerable devices and projects are covered in 40 pages.

Dowflake for Pavement Curing

The admixture method insures proper curing at lower cost in less time with *Dowflake* in the mix, according to the contents of a new folder of the *Dow Chemical Co.*, Midland, Mich.

Its advantages and use, both integrally and for surface curing, are covered briefly and concisely.

Concrete Paint

A durable paint for concrete, stucco and brick surfaces is *Tnemec*, according to an 8-page circular of the *Tnemec Paint and Oil Co.*, Kansas City, Mo.

Tnemec protective coatings are a combination of portland cement as a pigment with kettle-boiled linseed oil as a vehicle, to which are added proper tinting colors.

Calcium Chloride Dependability

For All Winter Concrete Work from Sewer Pipe to Skyscrapers is the title of a new 6-page folder stressing the dependability of *Solvay Calcium Chloride*. This is a new piece of literature of the *Solvay Sales Corp.*, New York City.

"Solvay Calcium Chloride is not a new or untried product. It has been used in practical cold weather concreting for many years and with impressive success. . . . State, county and municipal highway departments in all parts of the country have made provision in their specifications for the use of Calcium Chloride," it is stated.

Manufacturers' News

Calcium Chloride Representative

The Columbia Alkali Corp. announces the appointment of *H. W. Gleichert* as manager of special products sales, succeeding *Ray A. Giddings*, who leaves the organization to accept the office of secretary of the Calcium Chloride Association. This change became effective January 1st.

Dewey Cement Representative

The Dewey Portland Cement Co. has appointed *H. G. Nevins* as its representative in the Greater Chicago district.

In addition to selling Dewey portland cement, Mr. Nevins will also promote the sale of Dewey's two special products — *Dewey Masons' cement*, and *Dewey Super cement*, a rapid-hardening, waterproof portland cement.